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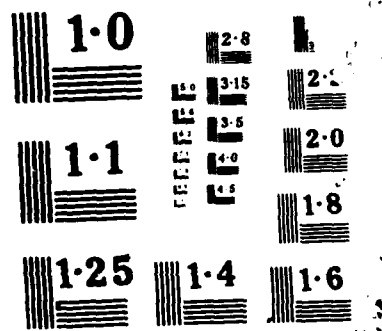
WESTERN PACIFIC OMEGA VALIDATION: PROJECT DESCRIPTION  
(U) NAVAL OCEAN SYSTEMS CENTER SAN DIEGO CA C P KUGEL  
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## REPORT DOCUMENTATION PAGE

1a SECURITY CLASSIFICATION AUTHORITY		1b RESTRICTIVE MARKINGS									
2a DECLASSIFICATION/DOWNGRADING SCHEDULE		3 DISTRIBUTION/AVAILABILITY OF REPORT									
		Approved for public release; distribution is unlimited.									
4 PERFORMING ORGANIZATION REPORT NUMBER(S)		5 MONITORING ORGANIZATION REPORT NUMBER(S)									
6a NAME OF PERFORMING ORGANIZATION	6b OFFICE SYMBOL (if applicable)	7a NAME OF MONITORING ORGANIZATION									
Naval Ocean Systems Center	NOSC	Naval Ocean Systems Center									
6c ADDRESS (City, State and ZIP Code)		7b ADDRESS (City, State and ZIP Code)									
San Diego, CA 92152-5000		San Diego, CA 92152-5000									
8a NAME OF FUNDING SPONSORING ORGANIZATION	8b OFFICE SYMBOL (if applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER									
U.S. Coast Guard	USCG										
8c ADDRESS (City, State and ZIP Code)		10 SOURCE OF FUNDING NUMBERS									
2100 2nd Street S.W. Washington, DC 20590		<table border="1"> <tr> <th>PROGRAM ELEMENT NO</th> <th>PROJECT NO</th> <th>TASK NO</th> <th>AGENCY ACCESSION NO</th> </tr> <tr> <td>OGVT</td> <td>MP01</td> <td>USCG</td> <td>DN213 001</td> </tr> </table>		PROGRAM ELEMENT NO	PROJECT NO	TASK NO	AGENCY ACCESSION NO	OGVT	MP01	USCG	DN213 001
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OGVT	MP01	USCG	DN213 001								
11 TITLE (Include Security Classification)											
Western Pacific Omega Validation: Project Description											
12 PERSONAL AUTHOR(S)											
C.P. Kugel											
13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT								
Professional paper	FROM Aug 1986 TO Aug 1986	November 1987									
16 SUPPLEMENTARY NOTATION											
17 COSATI CODES		18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)									
FIELD	GROUP	SUB-GROUP									
			qualitative observations								
			validation program								
			omega transmission format								
19 ABSTRACT (Continue on reverse if necessary and identify by block number)											
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20 DISTRIBUTION/AVAILABILITY OF ABSTRACT		21 ABSTRACT SECURITY CLASSIFICATION									
<input type="checkbox"/> UNCLASSIFIED UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		UNCLASSIFIED									
22a NAME OF RESPONSIBLE INDIVIDUAL		22b TELEPHONE (Include Area Code)									
C.P. Kugel		(819)225-7166									
		23 OFFICE SYMBOL Code 542									

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WESTERN PACIFIC OMEGA VALIDATION  
PROJECT DESCRIPTION\*

by

Carl P. Kugel\*\*

Abstract



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The Naval Ocean Systems Center (NOSC) in San Diego, California, has been tasked by the Omega Navigation System Center (ONSC) to perform the validation of the Omega System in the Western Pacific Ocean area. In early April 1986, a Coast Guard C-130H aircraft based at Clearwater, Florida was outfitted with specially-designed receiving equipment as used in previous validations for the Indian and the South Pacific Oceans and proceeded to gather approximately 120 flight hours of Omega signal information throughout the Western Pacific. These flights were performed in conjunction with simultaneous ground and shipboard measurements from several of ONSC's on-going monitor sites and ships operating in the region. Because no meaningful data analysis has been accomplished by this writing, this paper will be confined to describing the aircraft flight itinerary, ground monitor operations and qualitative observations from the overall mission.

INTRODUCTION

This paper briefly describes the Western Pacific Omega Validation of 1986, the latest in a continuing series of regional Omega validations. The overall validation program has been described by Doubt (1984). Equipment details for this validation are essentially similar to those for the Indian Ocean Validation (Kugel, 1984) and the South Pacific Validation (Kugel, 1985) as previously described. Results of the Indian Ocean tests have been reported by Swanson, et al (1985).

To briefly review, the basic aircraft receiving system consists of two Litton LTN-211 Omega Navigation System (ONS) units and a Hewlett-Packard Wave Analyzer/Selective Voltmeter. The standard cockpit ONS is driven by the existing loop (H-field) antenna; the rack mounted ONS is driven by the aircraft's ADF Towel-Bar antenna (E-field). Omega signal data together with position fix data from both ONS units, a dual Inertial Navigation System (one with LORAN-C update) and a Global Positioning System (GPS) are recorded simultaneously on a floppy-disc drive via a Hewlett-Packard HP-87 desktop computer terminal/display unit.

The calibration injection function of the 211's was used to "calibrate" the observed noise and thus permit the normally recorded signal-to-noise signal quality data to be converted into signal amplitude behavior. The Hewlett-Packard Voltmeter provided true signal amplitudes which are calibrated to absolute values by overflying Omega transmitters of known radiated power and subsequently used to adjust the Litton amplitude values to absolute levels as well. The HP meter normally can be tuned sequentially to only four Omega signals, but at approximately 3/4 hour intervals, complete scans of the entire Omega transmission format were put on stripcharts for subsequent manual compilation.

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A Cesium standard/portable clock is used to synchronize the system and to provide a reference frequency for the rack-mounted ONS.

Ground monitoring systems consisted of Magnavox MX-1104 receivers and their associated whip antennas. Modifications for these tests included speeding up the data recording rate to once every 6 minutes and insertion of an attenuator into the calibration injection line to provide a reduced level susceptible to and therefore, indicative of local noise.

#### FLIGHT ITINERARY AND GROUND MONITOR SITES

Figure 1 shows the aircraft flight itinerary as planned for the period of 11 April to 11 May 1986. With the following exceptions, actual flight routes were accomplished as planned:

(1) Because of preparations for an impending U.S. Presidential visit to Bali, Indonesia, embassy personnel requested that Flight 6 terminate at Jakarta, instead. To recover information lost by the re-routing of Flight 6, Flight 7 back-tracked towards Bali before commencing the planned data run to Bangkok.

(2) Because of additional commitments for the aircraft to visit Beijing, China as part of a U.S. trade show exhibit, validation measurements were concluded at Yokota, Japan after Flight 17.

(3) Not shown is Flight 1 from San Diego to Hawaii - the only flight intended to be flown during daytime. All other operations were at night, except that air-terminal closing periods required that landings at Hong Kong and Honiara be made shortly after sunrise.

Figure 1 also shows the location of the six ground monitors used to provide fixed-site signal information: Tsushima, Japan; Darwin, Australia; Cubi Pt., Philippines; Honiara, Guadalcanal; Singapore; and Yap, Micronesia. At these sites, the calibration injection function of the Magnavox receivers was used to provide calibrated signal amplitude information from the normally recorded SNR data similarly as is done for the aircraft system. Absolute field intensity measurements also were made at all sites. Because of delays in diplomatic approval for site installation, the Honiara site needed to be installed during the validation tests by the aircraft technical crew. Despite an unknown interference problem encountered during installation and a typhoon which devastated the Island a few days later, site installation is considered to have been successful.

#### PRELIMINARY RESULTS

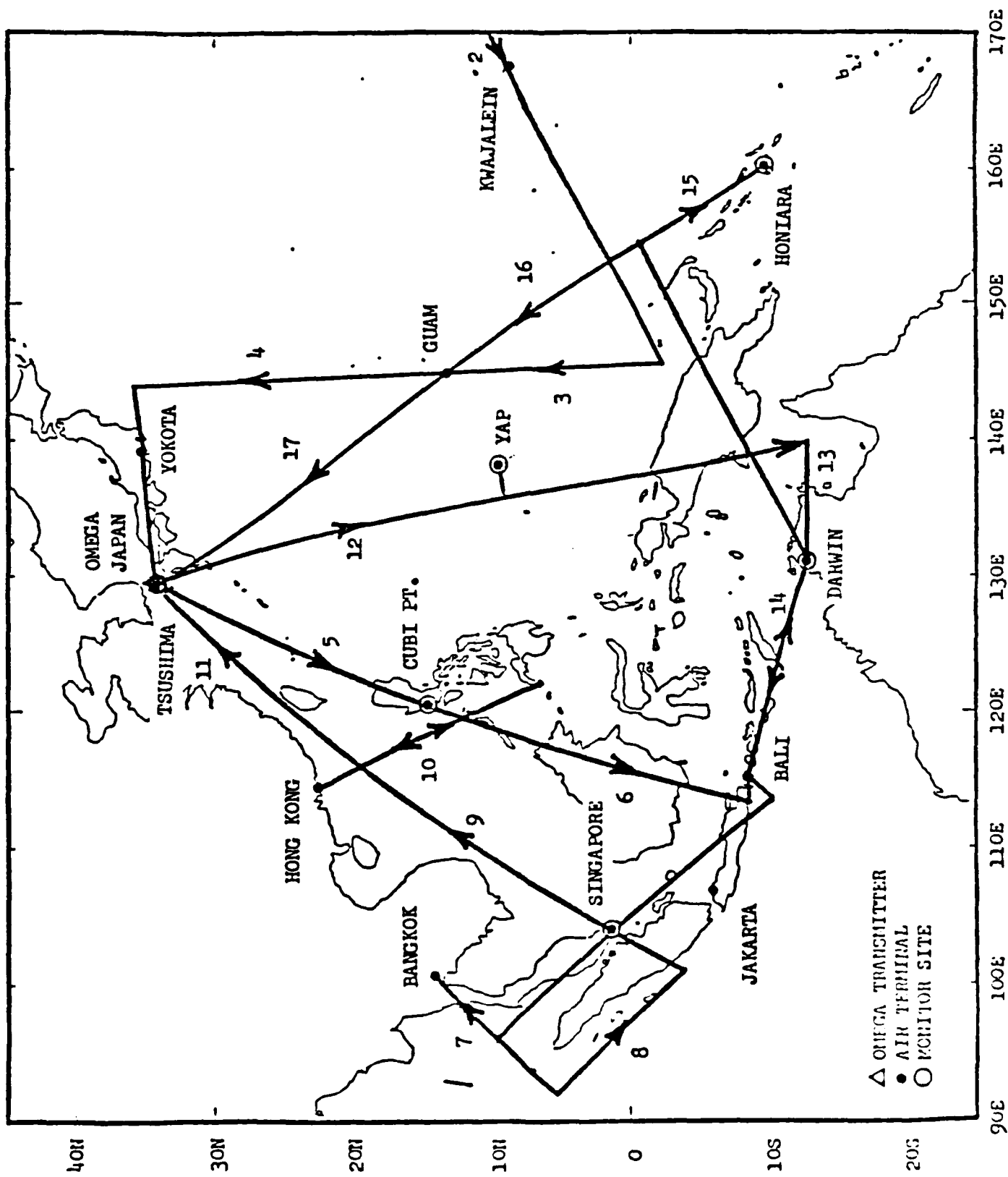
As noted above, no significant amount of data has been analyzed at this writing. However, some preliminary qualitative observations can be noted:

##### ONS Signal Tracking Performance

Unlike the previous experience in the South Pacific, neither ONS unit displayed any unusual susceptibility to interference from on-board sources. As is typical, the E-field system tended to show poorer SNR's but this should result in less data in the saturation region and therefore more data capable of being properly calibrated.

##### GPS Navigation Data

Although the cause was not determined, the GPS system (similar to that used in the South Pacific) never functioned properly during the tests and was not used beyond the midpoint of the flight period. A new antenna pre-amp and revised software were installed at Bangkok, but no changes were noticed. Since the system functioned normally in the laboratory prior to



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the flights, the assumption is that some component failure had occurred. Without the precise position information which could have been provided by GPS, data analyses probably will be constrained to signal amplitude variation. If position data from the INS is acceptably accurate, some analysis of Omega phase variation also can be made.

#### Australia Nighttime 10.2 kHz Coverage

Both ground data recorded at Tsushima, Japan (the monitor site for the Omega Japan transmitter) and in-flight data between there and Australia indicated that the Australia 10.2 kHz was too weak to track continually in that area during nighttime. Although the extent of this poor signal area will not be known until data analysis is complete, the present predicted coverage area for this signal most likely is too optimistic.

#### ONS Calibration Operation

Earlier LTN-211 units had been modified by Litton to permit the operator to manually override the receiver's choice for a calibration channel and to control the level of the calibration injection signal. Just prior to these flight tests, Litton completed additional modifications to further improve this manual calibration capability. In addition to providing an easier check on the proper setting of injection levels, these modifications may smooth out not only the "SNR" of the calibration/noise channel but also the signal amplitude data derived from it.

#### CONCLUSIONS

As with the two previous validations using a Coast Guard aircraft and the ONSC ground monitor sites, a significant amount of valuable data has been amassed during the Western Pacific Validation. There is every reason to expect that the results of analyzing these data will be as beneficial as for the Indian Ocean tests, especially with a view toward determining the nighttime coverage areas of Omega Japan and Australia.

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